

Impact-Actuated Digging Tool for Lunar Excavation, Phase I

Completed Technology Project (2009 - 2009)



Project Introduction

Honeybee Robotics proposes to develop a vacuum compatible, impact-actuated digging tool for the excavation of frozen and compacted regolith on the lunar surface and in the permanently shadowed craters of the lunar poles. This technology development effort will address the most challenging aspects of excavation in the lunar environment and work to develop a design relevant to a range of future lunar missions. This effort will also serve to guide and inform the requirements for the vehicles and systems that will be necessary for such missions. The fundamental architecture of an impact-actuated digging tool has been demonstrated for terrestrial applications for the Department of Defense. Honeybee's digging tool design is a novel approach ideally suited for lunar applications to defeat compacted and frozen regolith. By using the impact energy imparted by a reciprocating hammer transferred through the scoop to defeat the target material, the need for large reaction loads from the vehicle is minimized, allowing for a much smaller, lower mass system. This ongoing effort will serve to instruct and maximize the benefit to NASA.

Anticipated Benefits

Potential NASA Commercial Applications: There is an established interest from the Department of Defense in the development of digging tool technology appropriate for integration with small platform unmanned vehicles. Over 2000 such robotic platforms are currently fielded in Iraq and Afghanistan to deal with the persistent threat posed by Improvised Explosive Devices (IEDs), with more on the way. Currently these systems are unable to access buried IEDs commonly deployed as roadside bombs due to the inadequate end-of-arm tooling and the limited reaction forces available. Honeybee sees this related effort to develop an impact actuated digging tool for lunar applications as helping to advance the state of the art for this critical application. With the completion of this Phase I and Phase II effort and the related effort for the DoD for whom we have delivered and fielded a prototype of a very similar system, Honeybee Robotics will have matured the fundamental technology to a high TRL for both lunar and terrestrial applications. This will position Honeybee well to pursue flight contracts for future NASA missions, support activities critical to the military, and seek out commercial markets for robotic digging technology.



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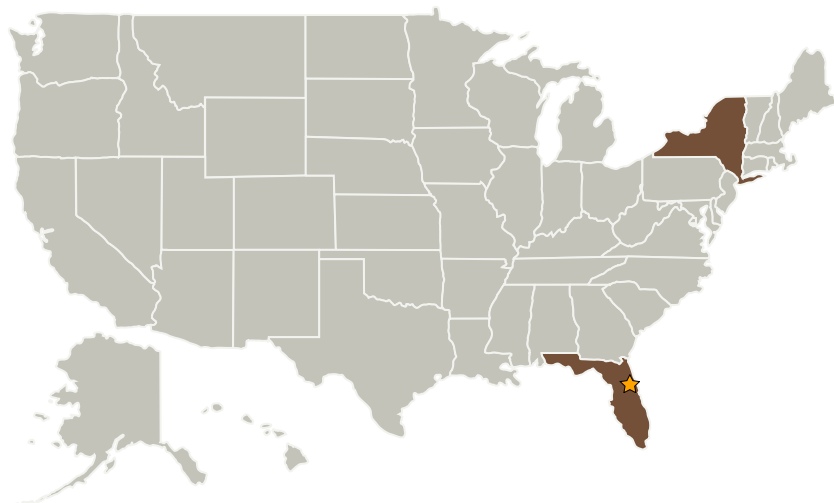
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
Honeybee Robotics, Ltd.	Supporting Organization	Industry	Pasadena, California

Primary U.S. Work Locations

Florida	New York
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Project Transitions

**January 2009:** Project Start**July 2009:** Closed out

Closeout Summary: Impact-Actuated Digging Tool for Lunar Excavation, Phase I Project Image

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

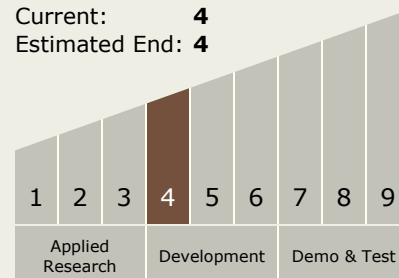
Kris Zacny

Technology Maturity (TRL)

Start: 4

Current: 4

Estimated End: 4



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Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
 - └ TX13.4 Mission Success Technologies
 - └ TX13.4.1 Mission Planning